

**ARCHIPS GOYERANA, N. SP. (LEPIDOPTERA: TORTRICIDAE) AN
IMPORTANT PEST OF BALDCYPRESS (TAXODIACEAE) IN LOUISIANA
AND MISSISSIPPI**

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Abstract.—*Archips goyerana*, new species, is described and illustrated from southern Louisiana and southwestern Mississippi. It appears to be host-specific on baldcypress (*Taxodium distichum*; Taxodiaceae) and has become a serious pest of that tree species since its discovery in 1983. Notes on its biology are given, and differences between it and its sister species, *A. argyrospila*, are outlined. Although morphological differences between *A. goyerana* and *A. argyrospila* are subtle, they are corroborated by differences in forewing pattern, larval food plant preferences, and molecular data.

Key words: Tortricinae, Archipini, *Taxodium*

Archips (Hübner) is a large genus of at least 80 species widely distributed in the Nearctic, Palearctic and Oriental regions (Razowski 1977, 1997). The fruittree leaf-roller, *Archips argyrospila* (Walker), is probably the most widespread of the approximately 25 species of *Archips* in North America. It is a notorious, polyphagous pest of orchard trees throughout the northern United States and southern Canada (Chapman and Lienk 1971, Smirle 1993, Meeker and Goyer 1994, Goyer and Chambers 1997). Owing to the presence of numerous geographic forms and its considerable phenotypic variation, MacKay (1962) and Goyer et al. (1995) suggested that *A. argyrospila* may consist of a number of different sibling species that are differentiated by food plant preference and/or geographical distribution. In this paper I describe *A. goyerana*, a sibling species that feeds on baldcypress (*Taxodium distichum* L. Rich., Taxodiaceae) in Louisiana and Mississippi. This species has inflicted serious and wide-

spread defoliation in southern Louisiana since its discovery in 1983 (Braun et al. 1990, Meeker and Goyer 1993, Goyer et al. 1995). Aerial surveys conducted annually have found as many as 60,000 ha of baldcypress forest affected by this insect in southern Louisiana (Goyer and Chambers 1997).

MATERIALS AND METHODS

Institutions are abbreviated throughout the text as follows: Essig Museum of Entomology (EMEC), University of California, Berkeley, Ca, USA; Louisiana State Arthropod Museum (LSAM), Baton Rouge, LA, USA; Mississippi Entomological Museum (MEM), Mississippi State, MS, USA; National Museum of Natural History (NMNH), Smithsonian Institution, Washington, DC, USA; University of Minnesota, Saint Paul (UMSP), MN, USA. Specimens were obtained from the EMEC, MEM, and Louisiana State University Agricultural Center (LSUAC), Baton Rouge, LA, USA.

Dissection methodology follows that summarized in Brown and Powell (1991) except that preparations were transferred to 95% isopropyl alcohol (instead of xylene) after the 95% EtOH wash, and all parts were slide-mounted with Euparal mounting medium (Bioquip, Gardena, CA) rather than Canada balsam. Forewing measurements were made with an ocular micrometer mounted in a Zeiss Stemi SV6 dissecting microscope. Terminology for genital structures follows Horak (1984). Colors were described with the standards of Kornerup and Wanscher (1983).

SYSTEMATICS

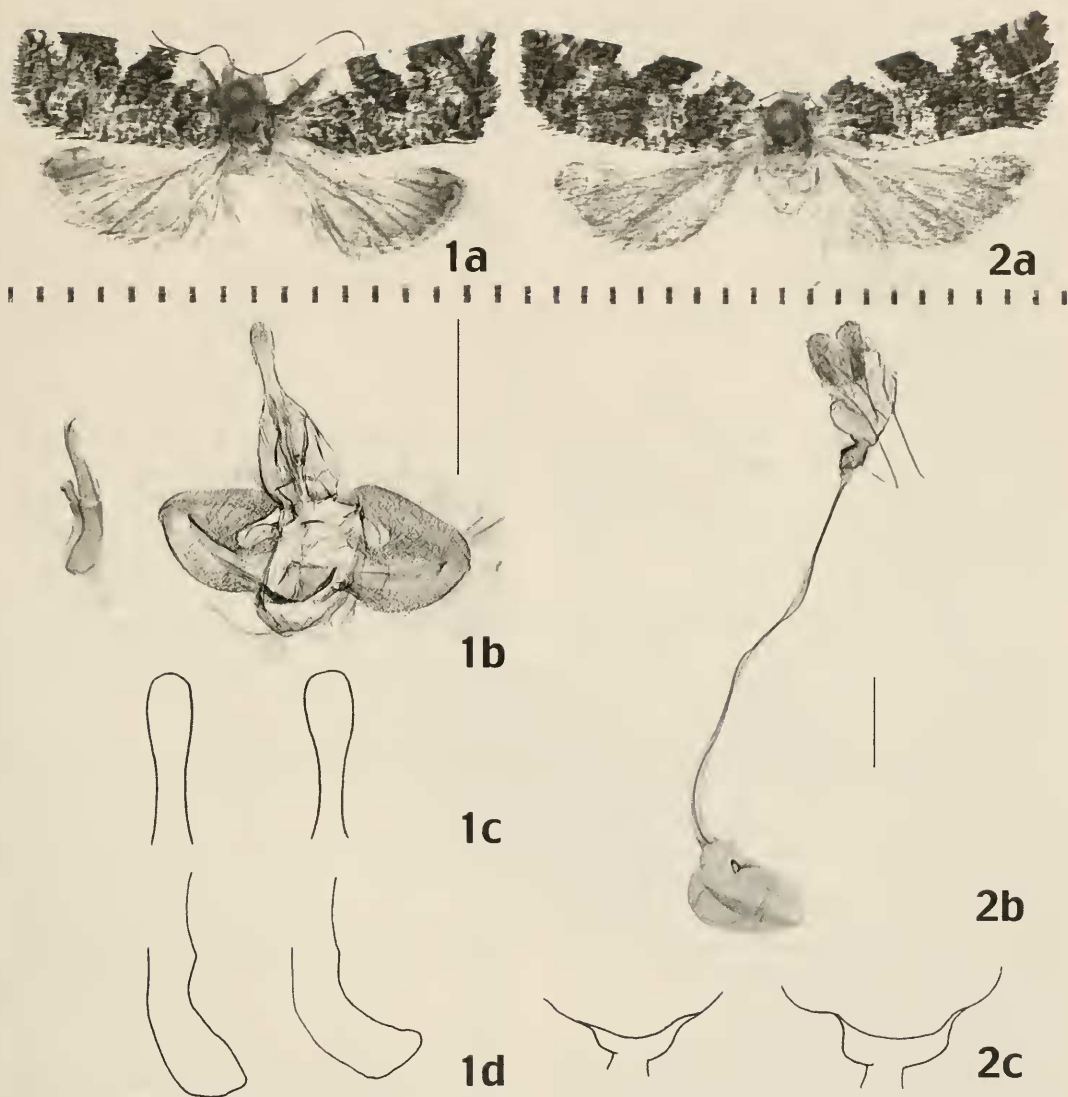
Archips goyerana Kruse, new species (Figs. 1–2)

Male (Fig. 1a).—*Head*: Vertex and upper frons golden yellow to brownish orange, brown or brownish orange between antennae in most specimens. Labial palpus with golden yellow and brownish orange scaling. *Mesonotum*: Golden yellow and brownish orange scaling, dark reddish brown scaling also present in many specimens; tegulae usually concolorous with mesonotum, but often with more brownish orange or reddish brown scaling. *Forewing*: Length 6.8–8.5 mm (mean 7.4 mm, $n = 37$). Costal fold extending from base to near proximal margin of median fascia, i.e., ca. 30–35% length of FW costa. Upper side with underscaling gray to grayish red, grayish red concentrated near center, extending basally and dorsally; overscaling pattern elements include distinct but broken reddish brown fasciae and black, broken strigulae and irregular white, yellowish white, gray, and golden yellow scaling throughout; basal fasciae indistinct; subbasal and median fasciae distinct and strongly contrasting with yellowish white interfascial regions near costa; postmedian fasciae distinct at costa, breaking dorsally; subterminal and terminal fasciae indistinct, represented by reddish brown strigulae or reddish brown patches, broken by yellowish white and

golden yellow scaling. Fringe gray with reddish brown and/or brownish orange scales replaced by gray scales at tornus. Under side with upper side pattern near costa, becoming gray dorsally in area of hindwing overlap. *Hindwing*: Upper side uniformly gray, except some dark gray and/or orange scaling near apex in some individuals. Under side gray, yellowish white near costa, orange strigulae or dark gray or orange scaling near apex. *Genitalia*: As in Fig. 1b (slide JJK 220; $n = 6$). Uncus large, prominent, slightly narrowed from base, slightly broadened apically, width of apex generally less than or equal to base (Fig. 1c). Gnathos arising from triangular projections of the tegumen, gently concavely curved and fused together apically, extending slightly beyond coastal margin of valva; socius vestigial; valva ovate; sacculus gradually broadening terminad with produced tip arising subapically of valva. Aedeagus straight or gently curved, terminating in slender tip strongly curved to left. Phallobase gently curved (Fig. 1d).

Female (Fig. 2a).—FW length 8.0–10.0 mm (mean 8.9 mm, $n = 50$). Superficially as in male except forewing ground color gray, with very little grayish red near center of wing, and generally with less yellowish white and golden yellow overscaling, but more black strigulae throughout. *Genitalia*: As in Fig. 2b (slide JJK 221; $n = 7$). Papillae anales setose, without projections; sterigma short, produced as a shallow bowl; antrum ovate; ductus bursae long; signa long, bladelike. Genitalia are virtually indistinguishable from *A. argyrospila* except for a more weakly produced sterigma (Fig. 2c).

Types.—Holotype ♂: LOUISIANA: Assumption Parish, Pierre Part, 27 April 1999 as pupa (R. A. Goyer), in LSAM. Paratypes: ($n = 101$). LOUISIANA: Assumption Parish, Pierre Part, 27 April 1999 as pupae, 14 ♂, 23 ♀ (R. A. Goyer); St. Charles Parish, Norco, 27 April 1999 as pupae, 19 ♂, 42 ♀ (R. A. Goyer); MISSISSIPPI: Hinds County, Clinton, 2 ♀, 18–19 May 1996 (M.



Figs. 1–2. Adults and genitalia of *Archips goyerana*. 1a, Male of *A. goyerana*, holotype, Assumption Parish, Louisiana; scale in mm. 1b, Male of *A. goyerana*; valvae spread, aedeagus removed, holotype, Assumption Parish, Louisiana, slide number JJK 220.; scale bar = 1 mm. 1c, Detail of uncus of male *A. goyerana* (left) and detail of uncus of male *A. argyrosipila* (right), Harrison County, Long Beach, Mississippi, drawn from slide number JJK 117. 1d, Detail of aedeagus of male *A. goyerana* (left) and detail of aedeagus of male *A. argyrosipila* (right). 2a, Female of *A. goyerana*, paratype, St. Charles Parish, Louisiana, scale in mm. 2b, Female of *A. goyerana*, paratype, St. Charles Parish, Louisiana, slide number JJK 221; scale bar = 1 mm. 2c, Detail of sterigma of female *A. goyerana* (left) and detail of sterigma of female *A. argyrosipila* (right), Bossier Parish, Barksdale Air Force Base, Louisiana, drawn from slide number JJK 214.

and E. Roshore); Harrison County, Long Beach, 1 ♀, 13 May 1997 (R. Kergosien). Paratypes are deposited in LSAM (36), MEM (10), UMSP (5), NMNH (20), and EMEC (30).

Diagnosis.—*Archips goyerana* was discovered in 1983 in Iberville Parish, Louisiana (Goyer and Lenhard 1988). It is very similar in appearance to *A. argyrosipila* but it is far less variable. In *A. goyerana* the

fasciae are usually dark reddish brown, interfascial spots are strongly contrasting with fasciae, and black striae are usually present. Interfascial spots are generally less well defined in *A. argyrospila*, and fasciae typically consist of various shades of brown or brownish orange. A pale form of *A. goyerana* is brownish orange on the forewing and pale brownish orange or light gray on the hindwing. This form appears to dominate in Mississippi and is difficult to distinguish from co-occurring *A. argyrospila*. In male genitalia of *A. argyrospila* the uncus is distinctly widened terminally, weakly club shaped (Fig. 1c). In addition, the phallobase in *A. argyrospila* is typically curved at an angle greater than 45° from the plane of the aedeagus as opposed to less than 35° in *A. goyerana* (Fig. 1d). Female genitalia of *A. goyerana* are nearly indistinguishable from those of *A. argyrospila*, although the sterigma tends to be slightly more robust and squarish in *A. argyrospila*, in comparison to the shallow mildly angled bowl of *A. goyerana* (Fig. 2c). Molecular data indicates a divergence ranging from 1.47 to 2.53% between *A. argyrospila* and *A. goyerana* in 475 base pairs of mitochondrial DNA in the Cytochrome Oxydase I gene, while widely separated populations of *A. argyrospila* differ by 1.26% or less (Kruse and Sperling, unpublished data).

Distribution and biology.—*Archips goyerana* occurs in southern Louisiana and southwestern Mississippi (Fig. 3). It originally may have been endemic to forested wetlands, but has undergone a population explosion and expansion of its range since 1983 (Goyer et al. 1990, Zhou et al. 1993, Goyer et al. 1995). In 1988, *A. goyerana* was found for the first time on baldcypress east of the Mississippi River (in Baton Rouge) and by 1993 had spread eastward to the suburbs of New Orleans (Goyer et al. 1995). Noticeable defoliation was evident over portions of at least eleven Louisiana parishes (Meeker and Goyer 1993, 1994). It was collected in southwestern Mississippi in 1996 (Clinton) and in 1997 (Long

Beach). *Archips argyrospila* and *A. goyerana* are known to co-occur near Baton Rouge, Louisiana and Long Beach, Mississippi. Individuals captured away from forested wetlands are speculated to feed on ornamental baldcypress.

Like *A. argyrospila*, *A. goyerana* is univoltine throughout its range, with overwintering egg masses attached to the bark of thin twigs of the host plant in obligate diapause (Braun et al. 1990, Goyer et al. 1990, Brown 1991, Meeker and Goyer 1993, Goyer and Chambers 1997). Dormant eggs hatch by bud break of baldcypress trees during late February and early March (Goyer et al. 1990, Meeker and Goyer 1993, Goyer and Chambers 1997). First instar larvae disperse and seek out the terminal portions of expanding baldcypress foliage, burrow within the cluster of young needles, and begin feeding inconspicuously (Goyer and Chambers 1997).

Larvae of *A. goyerana* feed on the opening leaf buds and elongating leaves (Braun et al. 1990). As the foliage expands, developing *A. goyerana* larvae produce silk to roll adjacent needles and branchlets into a tight mass, surrounding themselves individually and then feeding on the foliage inside (Braun et al. 1990, Goyer and Chambers 1997). Larvae remain inconspicuous on baldcypress unless the tree is severely defoliated, at which time they become very active, crawling on branches and spinning down on silk (Braun et al. 1990). Massive mortality to mature larvae by drowning in standing water was observed on many occasions where baldcypress were completely defoliated (Braun et al. 1990).

Larvae undergo five larval instars before pupation (Braun et al. 1990). Adults emerge between late-April and mid-May (Goyer and Chambers 1997). The development time for *A. argyrospila* from egg hatch to adult emergence takes about 6 weeks (Braun et al. 1990). For *A. goyerana*, development time is considerably longer, about 8 to 10 weeks on baldcypress in the field (Braun et al. 1990, Goyer and Cham-



Fig. 3. Range of *Archips goyerana* in Louisiana and Mississippi. Counties where *A. goyerana* is known to occur are shaded.

bers 1997). Previous studies have shown that *A. goyerana* is virtually unable to survive on oaks, a major food source for nearby populations of *A. argyrospila* (Goyer et al. 1995). Differences in pheromonal responses between citrus-feeding *A. argyrospila* and baldcypress-feeding *A. goyerana* populations suggest evolutionary divergence in mating behavior (Goyer et al. 1995). The forested wetland habitat of *A. goyerana* and the distant relationship between its food plant and the food plants of *A. argyrospila* further confirm that the two are distinct.

Archips goyerana is a wetlands pest in Louisiana. Repeated defoliation of baldcy-

press has been observed in several areas of southern Louisiana, with dramatic reductions in radial growth and death of portions of the tree canopy in all age groups, and mortality primarily in the small, understory trees that do not recover fully from complete and repeated defoliation (Goyer and Lenhard 1988, Goyer et al. 1990, Goyer and Chambers 1997). In addition, baldcypress defoliation is closely linked with excessive flooding, affecting tree successional patterns in forest wetlands (Goyer and Chambers 1997). With 70% of Louisiana's baldcypress growing stock located within or near areas now infested with *A. goyerana*, the persistence and continued spread of de-

foliation poses an additional threat to this dwindling and unique forest resource (Meeker and Goyer 1993).

Etymology.—The species is named for Richard A. Goyer of the Department of Entomology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, Louisiana. He collected the holotype as well as most of the paratypes, and is responsible for the majority of the research on the biology and ecology of the species.

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